

**Total Maximum Daily Loads
for
Shell Creek: LP1-20700**

Parameter of Concern: Atrazine

**Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division**

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Executive Summary

Shell Creek was included in the 2006 Nebraska Surface Water Quality Integrated Report (NDEQ 2006a) in Category 5 as impaired by excessive atrazine and selenium. As such, a total maximum daily load (TMDL) must be developed for each parameter in accordance with the Clean Water Act. A TMDL will not be developed for selenium based on the potential change in water quality criteria. The information contained herein should be considered one TMDL.

This TMDL has been prepared to comply with the current (1992) regulations found at 40 CFR Part 130.7.

1. **Name and geographic location of the impaired waterbody for which the TMDL is being developed.**
Lower Platte River Basin: Shell Creek, LP1-20700
2. **Identification of the pollutant and applicable water quality standard**
The pollutant causing the impairment(s) of the water quality standards and designated beneficial use (for which a TMDL will be developed) is atrazine. Designated uses assigned to the above-identified segments include: primary contact recreation, aquatic life Warmwater class B, agriculture supply class A and aesthetics (NDEQ 2006b). Excessive atrazine has been determined to be impairing the aquatic life beneficial use.
3. **Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.**
The allowable pollutant load is based upon the available stream flow volume. That is, loading capacities are developed for each flow by multiplying the water quality standard (WQS) by the selected stream flow and a conversion factor (C) with the equation being:
$$\text{Loading capacity} = \text{WQS} * \text{Flow} * C$$
4. **Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that is being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.**
Assessment of May-June atrazine data indicates 4 of 10 values exceed the applicable criteria.
5. **Identification of the pollutant source categories.**
The entire atrazine pollutant source has been determined to originate from nonpoint sources.
6. **Wasteload allocations for pollutants from point sources.**
The wasteload allocation for atrazine will be zero (0).
7. **Load allocations for pollutants from nonpoint sources.**

The load allocations assigned to this atrazine TMDL will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i * C_s * C$$

Where:

LA_i = load allocations at the i^{th} flow

Q_i = stream flow at the i^{th} flow

C_s = seasonal atrazine criteria

C = conversion factor

The load allocations assigned to this TMDL will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i * 12 \mu\text{g/l} * C$$

Where:

LA_i = load allocations at the i^{th} flow

Q_i = stream flow at the i^{th} flow

12 $\mu\text{g/l}$ = applicable/target water quality criteria for atrazine from Title 117

C = conversion factor

8 A margin of safety.

This TMDL contain an implicit and explicit margin of safety. The reduction necessary to support the beneficial use will be set at 55% whereas only a 45% reduction is needed to meet full support status. Also, implementation of controls will result in year-round protection of water quality. This will be important should application practices change in the future.

9. Consideration for seasonal variation.

Assessment and analysis of the data, as well as the TMDL was based on the May-June timeframe when atrazine application generally occurs and deviations from the water quality criteria have been observed.

10. Allowances for reasonably foreseeable increases in pollutant loads.

There was no allowance for future growth included in this TMDL.

11. Implementation Plan

The lead agency for pesticides and water quality issues in Nebraska is the Department of Agriculture (NDA). Implementation of the reductions for atrazine will be coordinated with the NDA.

This TMDL included in the following text can be considered a “phased TMDL” and as such are an iterative approach to managing water quality based on the feedback mechanism of implementing a required monitoring plan that will determine the adequacy of load reductions to meet water quality standards and revision of the TMDL in the future if necessary. A description of the future monitoring (Section 4.0) that is planned has been included.

Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected should be used to determine if the implemented TMDL has been or is effective in addressing the identified water quality impairments. As well the data and information can be used to determine if the TMDLs have accurately identified the required components (i.e. loading capacity, load allocations, etc.) and if revisions are appropriate.

1.0 Introduction

Shell Creek – Segment LP1-20700 – was included on Category 5 of the 2006 Nebraska Surface Water Quality Integrated Report (IR) (NDEQ 2006c). Category 5 is the Section 303(d) list of waterbodies that have been deemed impaired by one or more parameters and are in need of a TMDL. Data collected from 2002-2005 indicate the aquatic life beneficial use is impaired with the parameter of concern being atrazine.

In addition to atrazine, Shell Creek was also listed as impaired to excess selenium. In December 2004 EPA proposed a revision of the chronic criteria for selenium with the application being a fish tissue concentration. The status of this revision is still draft and the assessment of Shell Creek selenium data to the new criteria is unknown. Rather than proceed, the NDEQ will delay the development of a TMDL until the criteria are finalized. The waterbody will remain in Category 5 as impaired by selenium.

Based on the above, and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130, a TMDL has been developed for Shell Creek to address atrazine. Therefore, the information contained herein should be considered one (1) TMDL. Although only one segment is considered impaired, the relationship of water quality at the monitoring location and the watershed's contributions will be recognized. Concentration and load reduction activities will not be limited to the segment rather the watershed as a whole.

1.1 Background Information

Shell Creek is a tributary of the Platte River (LP1-20000) within sub-basin 1 of the Lower Platte River Basin. The stream heads in northeast Boone County and generally flows southeast then easterly (Figure 1.1a) before the confluence with the Platte River. There are four designated segments of Shell Creek included in Title 117 – Nebraska Surface Water Quality Standards (Title 117)(NDEQ 2006a) along with ten designated tributaries (Figure 1.1b).

A vast majority of the watershed is non-urbanized. Along with the TMDL, in 2004 the NDEQ initiated a locally led watershed management planning process to address all water quality concerns in the basin. Therefore, the TMDL will be developed for one segment but should be considered applicable to the entire watershed.

1.1.1 Waterbody Description

1.1.1.1 Waterbody Name and Stream Identification Number: Shell Creek – LP1-20700

1.1.1.2 Major River Basin: Missouri

1.1.1.3 Minor River Basin: Lower Platte

1.1.1.4 Hydrologic Unit Code (8 digit): 10200201

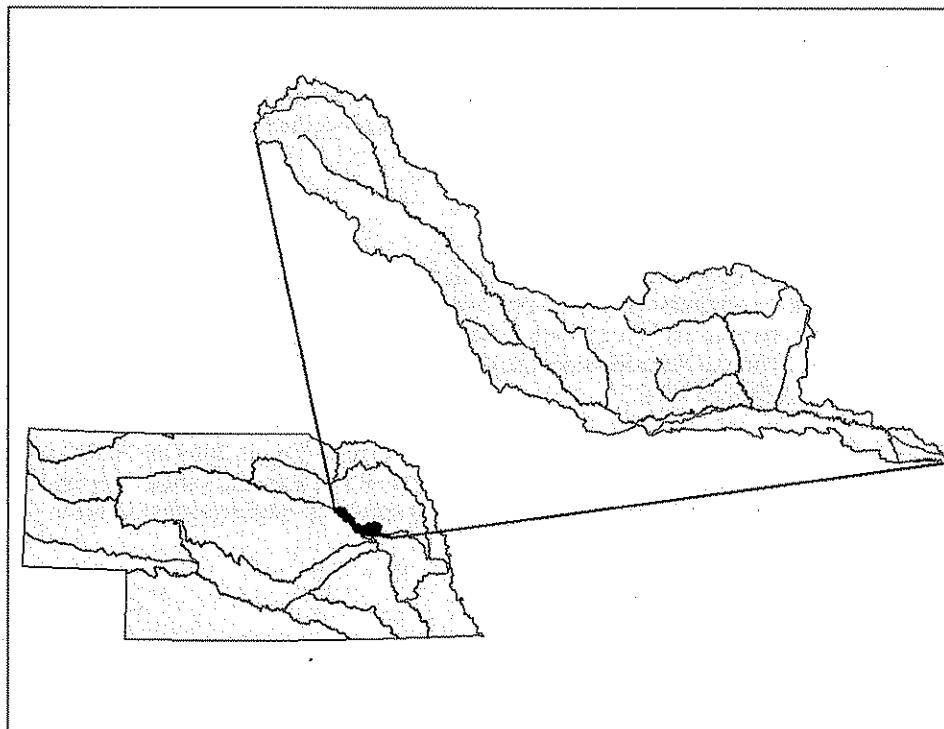
1.1.1.5 Assigned Beneficial Use: Warmwater aquatic life – class B, agriculture class A and aesthetics (Title 117 – Nebraska Surface Water Quality Standards).

1.1.1.6 Tributaries: Loseke Creek, Elm Creek, North Shell Creek

Table 1.1 Physical Description of Shell Creek

Parameter	Shell Creek
State	Nebraska
County (whole or in part)	Antelope, Boone, Colfax, Madison and Platte
Watershed Area	482 mi ²
Designated Stream Segments	14
Stream Miles (designated)	169 miles

Figure 1.1a Shell Creek in the Lower Platte River Basin

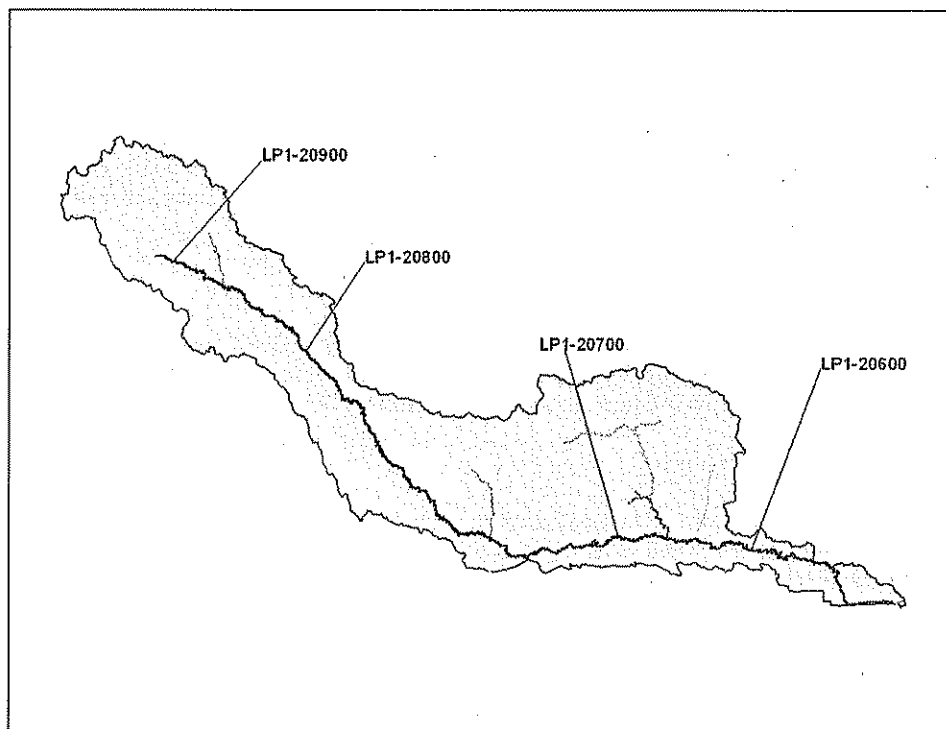


1.1.2 Watershed Characteristics

1.1.2.1 Physical Features: The Shell Creek watershed encompasses approximately 482 mi² in the east and northeast portion of the state. The basin originates in upper Boone and lower Antelope counties and ends at the confluence with Platte River near the city of Schuyler. The ecoregions of the basin include the Western Corn Belt and Central Great Plains (Chapman, et. al. 2001). Agriculture is the major land use.

The upper portion of the Shell Creek drainage area is composed of rolling hills and narrow tablelands between well defined drainage ways. On the lower lands, the valley is broad and flat and the drainage is poorly defined (NNRC 1974).

Figure 1.1b – Designated Shell Creek and Other Stream Segments in Shell Creek Watershed



- 1.1.2.2 Climate:** The average annual precipitation is approximately 27 inches (High Plain Regional Climate Center Web Site) with a majority of the precipitation occurring during the spring and early summer. Temperatures in the basin range from an average high in the 80's during the summer to average lows in the 10's during the winter.
- 1.1.2.3 Demographics:** Five municipal communities reside in the Shell Creek basin boundaries and range from a first class city to unincorporated villages. These include: Schuyler – population 5,406, Newman Grove – population 797, Platte Center – population 359 and Lindsay – population 276. Columbus – population 20,998 lies adjacent to the watershed.
- 1.1.2.4 Land Use:** The upland areas of the basin are generally devoted to cultivated cropland with small amounts of grassland. The broad alluvial lowlands of the Platte River valley are generally used for cultivated crops (NNRC 1974).

2.0 Atrazine TMDL

2.1 Problem Identification

Segment LP1-20700 was included in Category 5 of the 2006 Integrated Report as having an impaired aquatic life beneficial use with the parameter of concern being atrazine. This section deals with the extent and nature of the water quality impairments caused by excessive atrazine in the Shell Creek watershed.

2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The Warmwater B-Aquatic Life beneficial use has been deemed impaired within LP1-20700. The warmwater B aquatic life beneficial use applies to surface waters where a variety of warmwater biota is presently limited by water volume of flow, water quality (natural or irretrievable human-induced conditions), substrate composition, or other habitat conditions. These waters are only capable of maintaining year-round populations of tolerant warmwater fish and associated vertebrate and invertebrate organisms and plants. Key species may be supported on a seasonal or intermittent basis (e.g., during high flows) but year round populations cannot be maintained (NDEQ 2006a).

2.1.2 Data Sources

Atrazine data is collected as part of the Nebraska Ambient Stream Monitoring network. Within the Ambient Stream Network, samples are collected twice per month during April through September. Stream flow information was obtained from USGS Gage #06795500.

2.1.3 Water Quality Assessment

Water quality data assessments were based upon the beneficial use assessment procedures used to identify Category 5/impaired waters for the 2006 Integrated Report. The procedures are based on the application of the "binomial distribution" method that applies a confidence interval to the exceedance rate in an effort to determine the true exceedance of the waterbody versus the data set. A complete description of the water quality data assessment procedures can be found in the *Methodologies for Waterbody Assessments and Development the 2006 Integrated Report for Nebraska*, January 2006.

In the assessment process, all data will be initially assessed for seasonal variability in concentration or occurrence. This process will be accomplished by creating charts of time-series plots for each parameter of interest. These charts will be created from data gathered within the most recent 5-year monitoring period, or where continuous datasets exist (i.e., no more than a 2-year gap in data availability) over longer periods of time. If review of these charts reveals that seasonal differences occur, the NDEQ will focus its assessment efforts within the season(s) where parameter concentrations/occurrence are evident. By examining only the timeframe (seasons) where parameters appear in detectable levels, or at or near levels of concern, a waterbody can be more accurately assessed for use support / impairment. In contrast, when seasonal differences are present, but a long-term database is used to assess beneficial use support, the impacts to beneficial uses are underestimated and waters where real seasonal concerns exist may be overlooked.

The details of the assessment process to determine the use support of the Aquatic Life beneficial use can be found in table 2.1.3

Table 2.1.3 Assessment of the Aquatic Life Beneficial Use Using Chemical Water Quality Data

Supported	Impaired
≤10% of samples exceed acute or chronic water quality criteria	>10% of samples exceed acute or chronic water quality criteria

2.1.4 Water Quality Conditions

Atrazine data collected from 2002-2005 was assessed to determine the beneficial use support for the warmwater B aquatic life designation. Table 2.1.4 and figure 2.1.4 presents this information.

Table 2.1.4 Shell Creek 2002-2005 Data Assessment

Date Range	Number of Samples	Number of Samples >12 µg/l
January-December	53	4
May-June	10	4

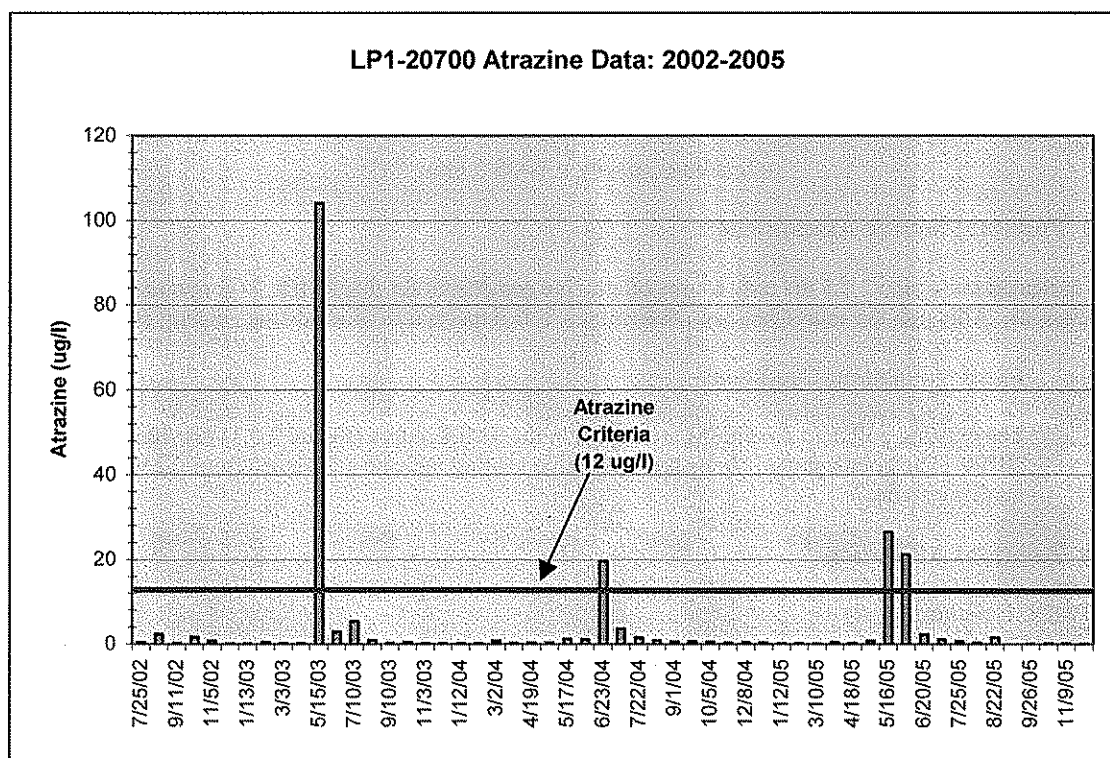
Based on the data assessment process a seasonal concern/impairment (May-June) exists for atrazine, which coincides with observed periods of increased precipitation and application of the herbicide. Because the impairment is seasonal, this TMDL will focus on that period.

2.1.5 Potential Pollutant Sources

Atrazine is a triazine herbicide currently registered for use against broadleaf and some grassy weeds. Atrazine is currently registered for use on corn (field and sweet); sorghum; range grasses for the establishment of permanent grass cover on rangelands and pastures under USDA's Conservation Reserve Program (CRP) in OK, NE, TX, and OR; wheat (where application is to wheat stubble on fallow land following wheat harvests; wheat is not the target crop); conifer forests; Christmas tree farms; sod farms; and golf courses (EPA 2006).

Atrazine is one of the most heavily used pesticides in North America (EPA 2003). Given this usage and source, point and natural sources are likely not contributing atrazine to surface waters in Nebraska. Therefore, for this TMDL the entire load will be considered the result of nonpoint source discharges.

Figure 2.1.4 Shell Creek (LP1-20700) Atrazine Data: 2002-05



2.2 TMDL Endpoint

The endpoint for this TMDL will be based on the numeric criteria associated with the Class B Warmwater Aquatic Life Beneficial Use.

2.2.1 Numeric Water Quality Criteria

Water quality criteria established for the Class B – Warmwater Aquatic Life protection of the beneficial use can be found in Title 117, Chapter 4. Assessment of the data and the TMDL are based on the chronic criterion of 12 µg/l.

2.2.2 Selection of Critical Environmental Conditions

The critical environmental conditions for this TMDL have been identified in the assessment process. Specifically, the data and information will be limited to the May-June timeframe when the deviations from the water quality criteria were observed.

2.2.3 Waterbody Pollutant Loading Capacity

Defining waterbody pollutant loading capacity implies a steady state. This TMDL recognizes loadings are dynamic and can vary with stream flow. As well, the above section indicates a potentially wide range of environmental conditions that must be accounted for.

The method chosen to account for the variation in flow is based upon a TMDL curve (NDEQ 2002). TMDL curves are initiated by the development of a stream's hydrograph using the long-term gage information. The flow information (curve) is then translated into a load curve by multiplying the flow values by the water quality standard (WQS) and a conversion factor (C). The acceptable "load" is then plotted graphically. Appendix B provides a table with the 0-100th percentile flow values and associated daily load values.

Therefore, the loading capacity for each of the segments will be defined by:

$$\text{Loading capacity} = \text{WQS} * \text{Flow} * C$$

2.3 Pollutant Source Assessment

As indicated in Section 2.1.5 the only source of atrazine considered for this TMDL is nonpoint source discharges. Although the source has been determined, it is important to illustrate the existing conditions.

2.3.1 Existing Pollutant Conditions

The existing pollutant conditions are shown in the TMDL curve (Figure 2.3.1) provided for LP1-20700. The points plotted above the acceptable loading indicate a deviance from the water quality criteria.

2.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

As stated above, the loading capacity is based upon flow position in the hydrograph and is defined by:

$$\text{Load Capacity} = \text{Flow} \times 12 \text{ µg/l} \times C$$

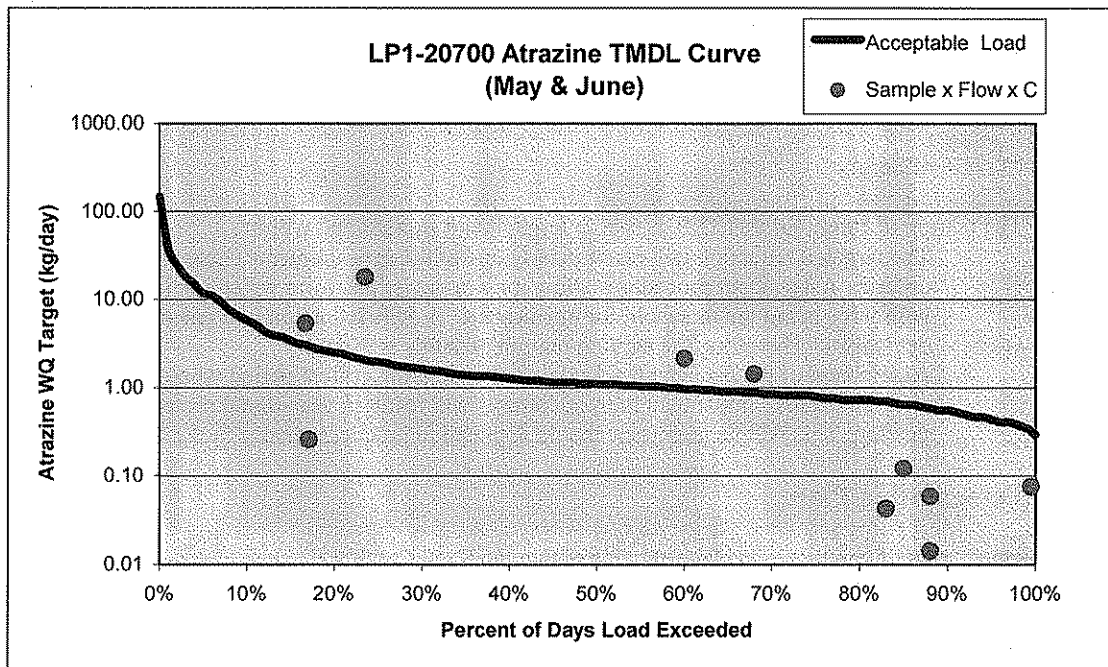
Where:

Flow = Stream flow volume (cubic feet per second)

12 µg/l = applicable/target water quality criteria atrazine from Title 117

C = conversion factor

Figure 2.3.1 Shell Creek (LP1-20700) TMDL Curve



2.4.1 Wasteload Allocation

As stated previously, elevated atrazine concentrations are typically not the result of point source discharges. For this TMDL the wasteload allocation will be zero (0).

2.4.2 Load Allocation

The load allocations assigned to this TMDL will be based upon the stream flow volume and will be defined as:

$$LA_i = Q_i * 12 \text{ } \mu\text{g/l} * C$$

Where:

LA_i = load allocations at the i^{th} flow

Q_i = stream flow at the i^{th} flow

12 µg/l = applicable/target water quality criteria for atrazine from Title 117

C = conversion factor

Because the WLA and natural background are zero (0) the entire loading capacity is the LA and can be found in Appendix B.

2.4.3 Natural Background

Atrazine does not occur naturally in the environment therefore the allocation for natural background will be zero (0).

2.4.4 Load Reduction to Meet Water Quality Criteria

It is important to report the reductions necessary to meet the water quality criteria. The necessary reductions were determined based upon the 2002-05 data, which is considered representative information. The targeted reductions provide water quality managers with a quantitative endpoint by which implementation planning can be carried out. In order to meet full support status the atrazine load must be reduced by 55%.

2.4.5 Margin of Safety

The margin of safety for this TMDL is both implicit and explicit and will be:

- The targeted reduction will result in only one of ten measurements exceeding the 12 µg/l criteria. Assessment procedures allow for two deviations from water quality standards with three being the threshold for impairment. A 45% reduction will result in 2 deviations. Therefore, the explicit margin of safety is 10%.
- Assessment of the data and the TMDL focused on the critical period where application of atrazine occurs. Implementation of controls will result in year-round protection of water quality. This will be important should application practices change in the future.

3.0 Implementation Plan

The implementation of controls to manage atrazine within the Shell Creek watershed includes but is not limited to:

3.1 Nebraska Department of Agriculture

The Nebraska Pesticide Act provides that the Nebraska Department of Agriculture (NDA) shall serve as the lead state agency in matters relating to pesticides and water quality. It further provides that NDA shall work closely with the Nebraska Department of Environmental Quality, Nebraska Department of Natural Resources, and the Nebraska Department of Health in matters relating to water quality.

Since 1995, the NDA has been the lead agency for the regulation of pesticides that might enter or pollute water and is responsible for development and implementation of state management plans for the prevention, evaluation and mitigation of occurrences of pesticides, or pesticide breakdown products, in ground and surface water. By working closely with those state agencies listed above as well as the Natural Resources Districts and others, NDA can be assured that the plans will be more comprehensive and effective in addressing these issues.

The NDA has been consulted in the completion of this TMDL and will be provided a copy upon EPA approval.

3.2 Section 319 – Nonpoint Source Management Program

The United States Environmental Protection Agency supplies grant funds to states to aid in managing nonpoint source pollution. When grant applications are submitted for review, an effort should be made to include the control of atrazine and surface run-off for the proposed projects in the Shell Creek watershed. As well, an effort will be made to redirect applicants to develop proposals consistent with the goals of this TMDL.

3.2.1 Shell Creek Water Quality Project

A Section 319 grant was awarded to the Prairie Land Resource Conservation and Development Council to organize and develop a locally led water quality improvement project. The project began in 2004 and will assist a local board of directors with developing and implementing water quality and other soil and water conservation issues in the Shell Creek watershed.

3.3 USDA-Natural Resource Conservation Service

The USDA-Natural Resource Conservation Service provides assistance utilizing programs under the control of the Service such as Conservation Reserve Program, Environmental Quality Incentives Program, Conservation Farm Option, Conservation of Private Grazing Land Initiative, the Wetlands Reserve Program and others that aid in the maintenance and improvement of water quality. The TMDL will be forwarded to NRCS for consideration in the implementation of these programs.

3.4 Non-Government Organizations

Several non-governmental organizations with an emphasis on agriculture disseminate information to their members on a regular basis. As well, some of the organizations have established environmental education programs to assist in the understanding of environmental regulations and topics. The NDEQ will communicate with these entities in an attempt to utilize the membership distribution process as a means of providing information on the water quality impairments, the TMDL and suggestions to assist in solving the identified problems.

3.5 Reasonable Assurance

As stated above, the NDA is the lead agency for issues that deal with pesticides and water quality. The TMDL was provided to the NDA prior to submittal for approval/disapproval. Once approved, coordination with the NDA will continue, including data collection and prioritization and nonpoint source program administration.

Through the Section 319 grant, the NDEQ has taken steps to address water quality within Shell Creek. However, effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative and coordinated effort by many agencies and organizations, both public and private. Each organization is uniquely equipped to deliver specific services and assistance to the citizens of Nebraska to help reduce the effects of nonpoint source pollution on the State's water resources. While a few of the organizations have been previously identified, Appendix A is a more complete compilation of those entities that may be included in the implementation process. These agencies have been identified as being responsible for program oversight or fund allocation that may be useful in addressing and reducing atrazine contributions to the Shell Creek watershed. Participation will depend on the agency/organization's program capabilities.

4.0 Future Monitoring

Future monitoring will generally be consistent with the ambient stream monitoring network. That is, a site continues to be maintained on Shell Creek. As well, an effort will be made to expand the monitoring to isolate areas of concern and to focus resources to address identified problems.

5.0 Public Participation

The availability of the TMDL in draft form was published in the Columbus Telegram and other newspapers with the public comment period running from approximately May 14, 2007 to June 18, 2007. This TMDL was also made available to the public on the NDEQ's Internet site and interested stakeholders were informed via email of the availability of the draft TMDL. No comments were received during the public participation period.

6.0 References

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NDEQ 2006b. Methodologies for Waterbody Assessments and Development the 2004 Integrated Report for Nebraska. Nebraska Department of Environmental Quality. Lincoln, NE.

NDEQ 2006c. 2004 Surface Water Quality Integrated Report. Nebraska Department of Environmental Quality. Lincoln, NE.

Appendix A – Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL

- ☐ *Bureau of Reclamation*
- ☐ *Environmental Protection Agency*
- ☐ *Fish and Wildlife Service*
- ☐ *Geological Survey*
- ☐ *Department of Agriculture - Farm Services Agency*
- ☐ *Department of Agriculture - Natural Resources Conservation Service*

STATE

- ☐ Nebraska Association of Resources Districts
- ☐ Department of Agriculture
- ☐ Department of Environmental Quality
- ☐ Department of Roads
- ☐ Department of Water Resources
- ☐ Department of Health and Human Services
- ☐ Environmental Trust
- ☐ Game and Parks Commission
- ☐ Natural Resources Commission
- ☐ University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- ☐ UN-IANR: Agricultural Research Division
- ☐ UN-IANR: Cooperative Extension Division
- ☐ UN-IANR: Conservation and Survey Division
- ☐ UN-IANR: Nebraska Forest Service
- ☐ UN-IANR: Water Center and Environmental Programs

LOCAL

- ☐ Natural Resources Districts
- ☐ County Governments (Zoning Board)
- ☐ City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS

- ☐ Nebraska Wildlife Federation
- ☐ Pheasants Forever
- ☐ Nebraska Water Environment Association
- ☐ Nebraska Corn Growers Association, Wheat Growers, etc.
- ☐ Nebraska Cattlemen's Association, Pork Producers, etc
- ☐ Other specialty interest groups
- ☐ Local Associations (i.e. homeowners associations)

Appendix B – 0-100th Percentile Flows and Maximum Daily Loadings for Shell Creek

Ranking/Percentile	Flow Value (cfs)	Maximum Daily Load (kg/day)
0	10	0.29
10	19	0.56
20	25	0.73
30	29	0.85
40	33	1
50	37	1.1
60	43	1.3
70	55	1.6
80	84	2.5
90	194	5.7
100	4900	144